

State of Wisconsin
2004
La Crosse Boiling Water Reactor
Environmental Radioactivity Survey

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State of Wisconsin DHFS

2004

LACBWR Environmental Radioactivity Survey

Introduction

Wisconsin Public Health Statutes 254.41 mandates the Department of Health and Family Services (DHFS) to conduct environmental radiation monitoring around the nuclear power facilities that impact Wisconsin. This environmental monitoring report is for the La Crosse boiling water reactor (LACBWR) for the calendar year January - December 2004 and provides a description and results of this environmental monitoring program.

WI DHFS LACBWR Environmental Monitoring Sampling Program

The WI DHFS environmental monitoring program consists of the collection of various types of samples from the air, water and terrestrial exposure pathways. The sampling program included samples of air, ambient gamma radiation (TLD), surface water, fish, bottom sediments, soil and vegetation that are collected from selected locations at planned sampling intervals.

Table 1 is a listing of sampling sites and includes a description, direction and distance from the monitored power plant. Table 2 provides a listing of the types of samples collected, sites where samples are collected, the number of samples collected, number of samples that were missed or had noted problems and a listing of the required analyses. Table 3 provides an explanation of missing samples or non-routine sample analyses. Figure 1 is a map showing the location of each environmental sampling site.

Program Modifications

On April 30, 1987, Dairyland Power Cooperative permanently shutdown the LACBWR facility. Their NRC licensee was amended to a possess-but-not-operate status on August 4, 1987 and they are now in the process of decommissioning the LACBWR facility. Since any severe accident involving the stored spent fuel will have little offsite consequences, the WI DHFS environmental radioactivity monitoring program was modified in June 1988. These modifications included the elimination of precipitation, shoreline sediment and well water samples as well as a reduction in vegetation, soil and some surface water sampling.

In response to this and considering other funding restrictions the LACBWR environmental monitoring program was reviewed and further modified in 1998, 1999 and 2000. Table 1 is a listing of presently used sampling sites that have been renumbered after eliminating sample sites that have been discontinued. Sampling sites that have been discontinued were last listed as sampling sites in WI DHFS's environmental monitoring report for the La Crosse boiling water reactor (LACBWR) for the calendar year of January - December, 1999.

There were no program modifications for 2004.

Laboratory Services and Quality Assurance

The analysis of the samples is performed under contract with the State Laboratory of Hygiene (SLH). SLH maintains their own quality assurance program. Analytical procedures provide for routine replicate analyses to verify methods and instrument operation. Traceable sources are used to

regularly calibrate the counters and daily performance checks are made between calibrations. In addition, quality control charts are maintained on the counters.

SLH participates in the Environmental Resource Associates' Proficiency Testing program and has performed satisfactorily over the report period. Proficiency testing results are available from the State Laboratory of Hygiene.

Detection Limits

Detection limits, required by WI DHFS, will be expressed as a lower limit of detection (LLD). The required WI DHFS LLD as indicated in Table 4 under the heading "LLD" is an "a priori" estimate of the capability for detecting an activity concentration by a given measurement system, procedure, and type of sample. Counting statistics of the appropriate instrument background are used to compute the LLD for each specific analysis. Using 4.66 times the standard deviation (s_b) of the instrument background, the LLD for each specific analysis is defined at the 95% Confidence Level.

The LLD for each radioisotope listed in Table 4 has been calculated from the following equation:

$$LLD = \frac{4.66 s_b}{E * V * 2.22 * Y * S * \exp(-dt)}$$

Where:

LLD	is the "a priori" lower limit of detection as defined above, as picocuries per unit mass or volume,
s_b	is the standard deviation of the background counting rate or of the counting rate of blank sample as appropriate, as counts per minute,
E	is the counting efficiency, as counts per disintegration,
V	is the sample size in units of mass or volume,
2.22	is the number of disintegrations per minute per picocurie,
Y	is the fractional radiochemical yield, when applicable,
S	is the self-absorption correction factor,
d	is the radioactive decay constant for the particular radionuclide, and
t	for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting.

Typical values for E, V, Y and dt have been used to calculate the LLD.

Reporting of Sample Analysis Results

Results for specific analyses will be reported as either a "less than" (<) value or an actual activity value. The reporting of results in Table 4 under the heading "Range" and in Tables 5-11 are "a posteriori" calculations based on the actual analysis performed using the actual sample values for E, V, Y and dt. Typically the reported "less than" (<) results are lower than the required WI DHFS LLD indicating that the required WI DHFS LLD has been met.

In late March and early April, SLH was in the process of upgrading from one software vendor to another for the qualitative and quantitative analysis of environmental samples. As a result some reported "less than" numbers for some analyses did not meet the required WI DHFS LLD. These reporting deviations have been indicated in Table 3.

An actual activity value will be accompanied by an uncertainty term for that analysis. The uncertainty term is a plus or minus counting uncertainty term at the 2 sigma (95%) confidence interval and is printed as (+- or \pm). Examples and explanations of data reporting are:

<u>Example</u>	<u>Nuclide</u>	<u>Activity reported</u>
1	^{137}Cs	< 10 pCi/liter
2	^{137}Cs	15 ± 3 pCi/liter

In example 1 we can be 95% confident that the sample activity, if any, is less than the MDC of 10 pCi/liter. In example 2 we can be 95% confident that the actual sample activity is greater than the MDC for that analysis and is between 12 and 18 pCi/liter.

Table 1. WI DHFS LACBWR environmental monitoring sampling sites.

Sample site	Distance and direction (miles)	Location description
LAC-1	15.0 N	La Crosse State Office Building
LAC-2	0.6 N	Lock & Dam #8
LAC-3	0.1 WSW	discharge channel
LAC-4	0.7 SSW	boat launch area
LAC-5	0.6 NNE	Hwy 35 parking lot
LAC-6	0.7 S	boat launch access road
LAC-7	0.8 ENE	Philip Malin farm (discontinued beginning January 2001)
LAC-T1	0.6 N	Lock & Dam #8
LAC-T2	2.0 E	Radio tower, Mound Ridge road
LAC-T3	0.5 SSE	Trailer court, Hwy 35
LAC-T4	15.0 N	La Crosse State Office Building

Table 2. Sample collection summary and required analyses for 2004.

Sample Type	Collection and Frequency	Site locations	Number of Samples Collected	Number of Sample Deviations	Required Analyses
Air Particulate	BW	1, 2	53	2	GA, GB, GI
TLD	G/Q	T1-T4	16	0	direct exposure
Surface Water	G/Q	2, 3	8	1	GA, GB, GI, Sr, H
Bottom Sediment	G/SA	2, 3, 4	6	0	GA, GB, GI
Fish	G/Q	3	8	0	GI
Vegetation	G/SA	5, 6	4	0	GA, GB, GI
Soil	G/SA	5, 6	4	0	GA, GB, GI

Collection type: C/ = continuous; G/ = grab

Frequency: /W = weekly; /M = monthly; /Q = quarterly; /A = annually; /BW = bi-weekly; /SA = semi-annually

Required analyses: GA = gross alpha; GB = gross beta; GI = gamma isotopic; Sr = strontium; H = tritium

Table 3. WI DHFS missing sample or non-routine analysis report for 2004.

Sample type	Date	Site	Explanation
Air Particulate	05/25/04	LAC-2	Due to equipment problems, gross beta data was not available for the indicated collection period.
Air Particulate	1st quarter	LAC 1,2	In late March and early April, SLH was in the process of upgrading from one software vendor to another for the qualitative and quantitative analysis of environmental samples. As a result some reported "less than" numbers for some analyses did not meet the required WI DHFS LLD.
Surface Water	04/13/04	LAC 2	In late March and early April, SLH was in the process of upgrading from one software vendor to another for the qualitative and quantitative analysis of environmental samples. As a result some reported "less than" numbers for some analyses did not meet the required WI DHFS LLD.

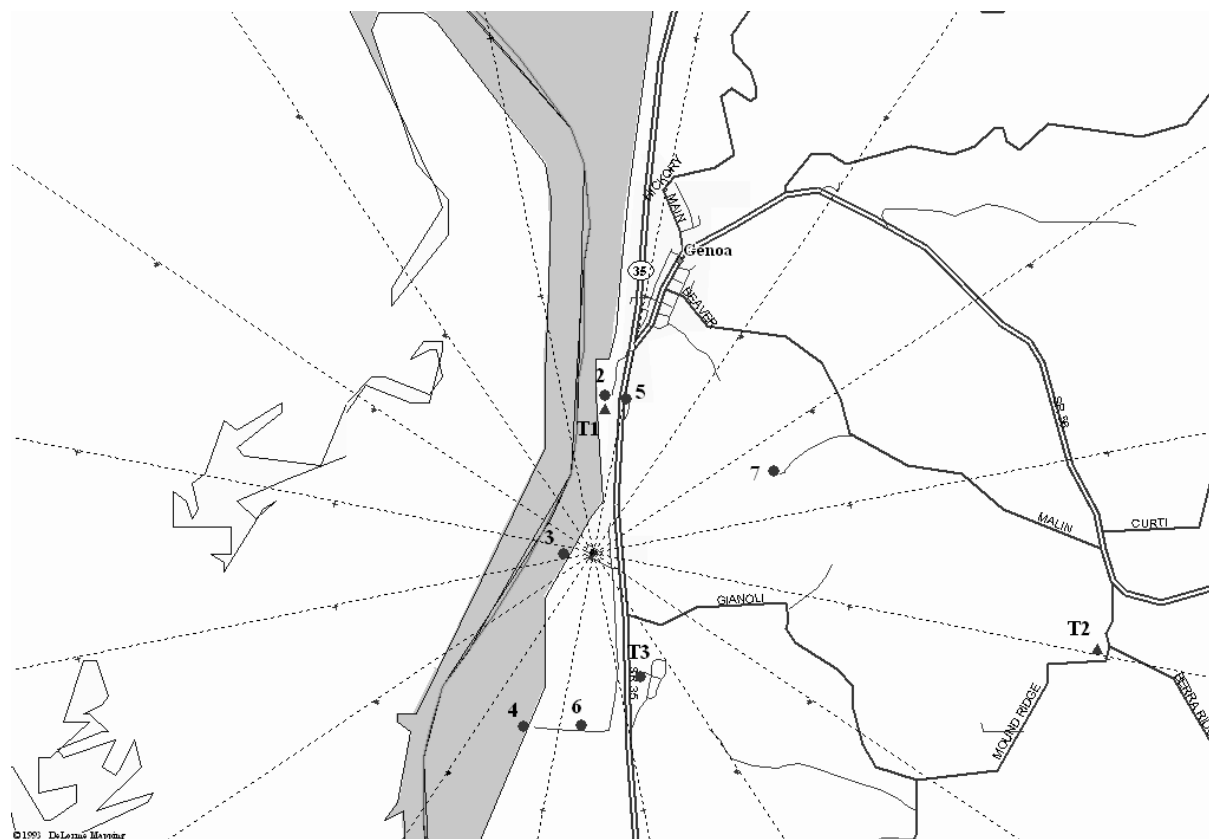


Figure 1. LACBWR environmental monitoring sampling sites.

Results And Discussion

Air Particulate

A summary of reported activities by WI DHFS for air particulate samples is included in Table 4. Results from the individual sample analyses are listed in Tables 5 and 6.

From the quarterly gross beta activities listed in Table 5 it may be noted that there are no significant differences due to distance from the LACBWR facility. With no significant differences due to distance from the LACBWR facility an increase in gross beta activity attributable to LACBWR is not evident.

The gamma isotopic analysis of the quarterly air particulate filter composites detected only small amounts of the radioisotopes listed in Table 4. All other radioisotopes were below their respective minimum detectable concentration. Naturally occurring beryllium-7 (^7Be), detected in all composites, is constantly produced through nuclear reactions between cosmic rays and nuclei in the atmosphere and is detected in air composites from other areas of the state.

Influence by the LACBWR facility on air quality is not evident from air particulate analysis.

Direct Radiation - Thermoluminescent Dosimeters (TLD's)

A summary of reported activities by WI DHFS for direct radiation is included in Table 4. Results from the individual sample analyses are listed in Table 7.

Direct radiation (TLD) data for 2004 from the WI DHFS network was comparable for all sites. Significant differences in exposure were not noticed at different distances from the LACBWR facility. The average quarterly exposure from the four sites located within Wisconsin was 14.2 ± 1.8 milliroentgens. The average quarterly exposure for 2004 is at background levels and is comparable to other areas within Wisconsin.

Fish

A summary of reported activities by WI DHFS for fish samples is included in Table 4. Results from the individual sample analyses are listed in Table 8.

The fish samples showed no unusual activities. Naturally occurring potassium-40 (^{40}K) was reported in all samples. All other radioisotopes were below their respective minimum detectable concentration.

Surface Water

A summary of reported activities by WI DHFS for surface water samples is included in Table 4. Results from the individual sample analyses are listed in Table 9.

The surface water samples showed no unusual activities. All detected activities are at background levels and are comparable to data from previous years. The surface water samples uniformly show activities below state or federal standards.

Bottom sediments

A summary of reported activities by WI DHFS for bottom sediment samples is included in Table 4. Results from the individual sample analyses are listed in Table 10.

The naturally occurring radioisotope potassium-40 (^{40}K) was detected in all samples. The gamma isotopic analysis of the bottom sediment samples taken at site LAC-3 detected small activities for cobalt-60 (^{60}Co) and cesium-137 (^{137}Cs). The reported activities for cesium-137 (^{137}Cs) and cobalt-60

(⁶⁰Co) can be attributable to past effluent discharges from the LACBWR facility and have also been detected in previous years. Naturally occurring radioisotopes such as radium-226 (²²⁶Ra), bismuth-214 (²¹⁴Bi), lead-214 (²¹⁴Pb), actinium-228 (²²⁸Ac), bismuth-212 (²¹²Bi) and lead-212 (²¹²Pb) from the naturally occurring uranium-238 (²³⁸U) and thorium-232 (²³²Th) decay series are commonly detected but have not been quantified or reported.

Vegetation

A summary of reported activities by WI DHFS for vegetation samples is included in Table 4. Results from the individual sample analyses are listed in Table 11.

Analysis of the vegetation samples showed no unusual activities. The gamma isotopic analysis detected only small amounts of naturally occurring potassium-40 (⁴⁰K) and beryllium-7 (⁷Be) listed in Table 4.

Soil

A summary of reported activities by WI DHFS for soil samples is included in Table 4. Results from the individual sample analyses are listed in Table 11.

Analysis of the soil samples showed no unusual activities. The naturally occurring radioisotopes potassium-40 (⁴⁰K) was detected in all samples. The reported activities for cesium-137 (¹³⁷Cs) were also detected in previous years and are attributable to residual fallout from previous atmospheric nuclear weapons tests. Naturally occurring radioisotopes such as radium-226 (²²⁶Ra), bismuth-214 (²¹⁴Bi), lead-214 (²¹⁴Pb), actinium-228 (²²⁸Ac), bismuth-212 (²¹²Bi) and lead-212 (²¹²Pb) from the naturally occurring uranium-238 (²³⁸U) and thorium-232 (²³²Th) decay series are commonly detected but have not been quantified or reported.

Dose to an Average Individual

Federal regulations 10 CFR 20, 10 CFR 50 Appendix I and 40 CFR 190 restrict the annual exposure of the population from all parts of the nuclear fuel cycle, including nuclear power plants. Doses resulting from gaseous and liquid effluent releases from the LACBWR facility are less than the limits as stated in these Federal regulations.

The WI DHFS limits for permissible levels of radiation exposure from external sources in unrestricted areas are defined in the Wis. Adm. Code section HFS 157.23. Doses resulting from gaseous and liquid effluent releases from the LACBWR facility are less than the limits as stated in Wis. Adm. Code section HFS 157.23.

References

State of Wisconsin, Wisconsin Administrative Code, HFS 157.23

U.S. Environmental Protection Agency, Environmental Radiation Requirements for Normal Operations of Activities in the Uranium Fuel Cycle, EPA 520/4-76-016, 40 CFR Part 190, November 1976.

U.S. Nuclear Regulatory Commission, Title 10, Part 20.

U.S. Nuclear Regulatory Commission, Title 10, Part 50, Appendix I.

Table 4. Sample activity summary for 2004 for the WI DHFS LACBWR environmental monitoring program.

Sample type (units)	MDC	Number of samples ^a	Analysis	Range
Air Particulate (pCi/m ³)	0.003	53 / 53	gross beta	0.010 - 0.043
			gamma isotopic	
	0.015	8 / 8	Be-7	0.039 - 0.073
	0.002	8 / 0	Mn-54	< 0.0005
	0.002	8 / 0	Co-58	< 0.0007
	0.010	8 / 0	Fe-59	< 0.0022
	0.005	8 / 0	Co-60	< 0.0006
	0.010	8 / 0	Zn-65	< 0.0011
	0.003	8 / 0	Nb-95	< 0.0014
	0.006	8 / 0	Zr-95	< 0.0014
	0.004	8 / 0	Ru-103	< 0.0011
	0.010	8 / 0	Ru-106	< 0.0043
	0.010	8 / 0	I-131	< 0.35
	0.002	8 / 0	Cs-134	< 0.0004
	0.002	8 / 0	Cs-137	< 0.0004
	0.020	8 / 0	Ba-140	< 0.039
	0.010	8 / 0	La-140	< 0.019
	0.004	8 / 0	Ce-141	< 0.0021
	0.006	8 / 0	Ce-144	< 0.0026
Direct Exposure (mR/Std Qtr)	1.0 ^c	16 / 16	direct exposure	11.1 - 17.2
Surface Water (pCi/liter)	2.5	8 / 6	gross beta (sol)	< 2.4 - 4.0
	2.5	8 / 0	gross beta (insol)	< 2.5
	2.8	8 / 0	gross alpha (sol)	< 2.3
	2.8	8 / 0	gross alpha (insol)	< 1.4
	700	8 / 0	H-3	< 300
	4.0	8 / 0	Sr-89	< 1.0
	1.0	8 / 2	Sr-90	< 0.4 - 0.7
			gamma isotopic	
	13	8 / 0	Mn-54	<22
	15	8 / 0	Co-58	< 19
	30	8 / 0	Fe-59	< 41
	15	8 / 0	Co-60	< 22
	30	8 / 0	Zn-65	< 39
	15	8 / 0	Nb-95	< 21
	30	8 / 0	Zr-95	< 38
	20	8 / 0	I-131	< 26
	13	8 / 0	Cs-134	<21
	12	8 / 0	Cs-137	< 21
	60	8 / 0	Ba-140	< 90
	20	8 / 0	La-140	< 27

Table 4. Sample activity summary for 2004 for the WI DHFS LACBWR environmental monitoring program.

Sample type (units)	MDC	Number of samples ^a	Analysis	Range
Fish (pCi/kg wet)			gamma isotopic	
	600	8 / 8	K-40	2900 - 3930
	50	8 / 0	Mn-54	< 39
	65	8 / 0	Co-58	< 54
	145	8 / 0	Fe-59	< 120
	70	8 / 0	Co-60	< 42
	130	8 / 0	Zn-65	< 90
	50	8 / 0	Nb-95	< 60
	100	8 / 0	Zr-95	< 100
	50	8 / 0	Cs-134	< 37
	60	8 / 0	Cs-137	< 35
Bottom Sediment (pCi/kg dry)	6000	6 / 5	gross beta	< 6000 - 21000
	8000	6 / 0	gross alpha	< 7000
			gamma isotopic	
	700	6 / 6	K-40	4850 - 14200
	60	6 / 0	Mn-54	< 18
	90	6 / 0	Co-58	< 27
	600	6 / 0	Fe-59	< 100
	90	6 / 1	Co-60	< 20 -104
	300	6 / 0	Zn-65	< 56
	100	6 / 0	Nb-95	< 70
	200	6 / 0	Zr-95	< 48
	80	6 / 0	Cs-134	< 24
	80	6 / 4	Cs-137	< 5 - 220
Vegetation (pCi/kg wet)	5000	4 / 0	gross alpha	< 1900
	5000	4 / 4	gross beta	4400 - 6500
			gamma isotopic	
	800	4 / 4	Be-7	910 - 2300
	1500	4 / 4	K-40	3300 - 6000
	90	4 / 0	Mn-54	< 60
	100	4 / 0	Co-58	< 70
	200	4 / 0	Fe-59	< 140
	100	4 / 0	Co-60	< 70
	250	4 / 0	Zn-65	< 120
	100	4 / 0	Nb-95	< 70
	200	4 / 0	Zr-95	< 120
	130	4 / 0	I-131	< 80
	80	4 / 0	Cs-134	< 60
	90	4 / 0	Cs-137	< 70
	350	4 / 0	Ba-140	< 270
	100	4 / 0	La-140	< 110

Table 4. Sample activity summary for 2004 for the WI DHFS LACBWR environmental monitoring program.

Sample type (units)	MDC	Number of samples ^a	Analysis	Range
Soil (pCi/kg dry)	6000	4 / 4	gross beta	18000 - 48000
	10000	4 / 1	gross alpha	< 6000 - 12000
			gamma isotopic	
	700	4 / 4	K-40	12000 - 38400
	60	4 / 0	Mn-54	< 29
	90	4 / 0	Co-58	< 37
	600	4 / 0	Fe-59	< 110
	90	4 / 0	Co-60	< 32
	300	4 / 0	Zn-65	< 90
	100	4 / 0	Nb-95	< 50
	250	4 / 0	Zr-95	< 70
	80	4 / 0	Cs-134	< 50
	80	4 / 2	Cs-137	< 27 - 98
<p>a - Number of analysis / number of analyses detected above the WI DHFS MDC.</p> <p>b - MDC activities expressed in units of pCi/liter.</p> <p>c - 1.0 mR / TLD</p>				

Table 5. WI DHFS air particulate gross beta analysis results from the WI DHFS LACBWR environmental monitoring program.

Measurements in units of pCi/m³

LAC-1, LaCrosse State office building

Collection Date	Volume m ³	Gross Beta
01/07/04	1090	0.034 +- 0.002
01/20/04	891	0.037 +- 0.002
02/03/04	952	0.033 +- 0.002
02/18/04	1007	0.043 +- 0.002
03/03/04	927	0.028 +- 0.002
03/16/04	867	0.023 +- 0.002
03/29/04	864	0.015 +- 0.002

1st qtr
mean +- s.d. **0.030 +- 0.009**

04/13/04	980	0.014 +- 0.001
04/27/04	918	0.016 +- 0.002
05/10/04	824	0.017 +- 0.002
05/25/04	898	0.012 +- 0.001
06/08/04	821	0.014 +- 0.002
06/25/04	979	0.011 +- 0.001

2nd qtr
mean +- s.d. **0.014 +- 0.002**

07/06/04	613	0.019 +- 0.002
07/19/04	727	0.014 +- 0.002
08/02/04	771	0.023 +- 0.002
08/16/04	741	0.017 +- 0.002
09/01/04	880	0.019 +- 0.002
09/13/04	700	0.026 +- 0.002
09/27/04	886	0.025 +- 0.002

3rd qtr
mean +- s.d. **0.020 +- 0.004**

10/12/04	988	0.019 +- 0.002
10/25/04	863	0.014 +- 0.002
11/09/04	979	0.019 +- 0.002
11/23/04	923	0.030 +- 0.002
12/07/04	904	0.027 +- 0.002
12/20/04	851	0.029 +- 0.002
01/04/05	963	0.038 +- 0.002

4th qtr
mean +- s.d. **0.025 +- 0.008**

LAC-2, Lock & Dam #8

Collection Date	Volume m ³	gross beta
01/05/04	1027	0.035 +- 0.002
01/19/04	1055	0.035 +- 0.002
02/02/04	1080	0.027 +- 0.002
02/18/04	1195	0.040 +- 0.002
03/03/04	983	0.028 +- 0.002
03/15/04	824	0.021 +- 0.002
03/29/04	951	0.015 +- 0.001

1st qtr
mean +- s.d. **0.029 +- 0.009**

04/13/04	979	0.014 +- 0.001
04/26/04	819	0.017 +- 0.002
05/11/04	933	0.018 +- 0.002
*a 05/25/04		
06/07/04	795	0.010 +- 0.002
06/25/04	1111	0.011 +- 0.001

2nd qtr
mean +- s.d. **0.012 +- 0.006**

07/06/04	634	0.016 +- 0.002
07/19/04	778	0.011 +- 0.002
08/02/04	833	0.020 +- 0.002
08/16/04	844	0.013 +- 0.002
09/01/04	993	0.019 +- 0.002
09/13/04	691	0.022 +- 0.002
09/27/04	833	0.025 +- 0.002

3rd qtr
mean +- s.d. **0.018 +- 0.005**

10/11/04	852	0.020 +- 0.002
10/25/04	885	0.015 +- 0.002
11/10/04	1002	0.017 +- 0.002
11/23/04	822	0.027 +- 0.002
12/07/04	907	0.024 +- 0.002
12/20/04	992	0.025 +- 0.002
01/05/04	1159	0.034 +- 0.002

4th qtr
mean +- s.d. **0.023 +- 0.006**

a - Due to equipment problems, gross beta data was not available for the indicated collection period.

Table 6. WI DHFS gamma isotopic analysis results of quarterly composites of air particulate samples collected for the WI DHFS LACBWR environmental monitoring program.

Measurements in units of pCi/m³

WI DHFS data		LAC-1, LaCrosse State Office Building			
Radioisotope		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7		0.045 +- 0.002	0.063 +- 0.002	0.073 +- 0.003	0.049 +- 0.002
Mn-54		< 0.0002	< 0.0003	< 0.0005	< 0.0002
Co-58		< 0.0003	< 0.0004	< 0.0007	< 0.0003
Fe-59		< 0.0013	< 0.0010	< 0.0020	< 0.0009
Co-60		< 0.0002	< 0.0003	< 0.0005	< 0.0002
Zn-65		< 0.0004	< 0.0007	< 0.0010	< 0.0006
Nb-95		< 0.0008	< 0.0005	< 0.0013	< 0.0005
Zr-95		< 0.0007	< 0.0008	< 0.0013	< 0.0006
Ru-103		< 0.0006	< 0.0004	< 0.0011	< 0.0004
Ru-106		< 0.0016	< 0.0028	< 0.0037	< 0.0019
I-131		< 0.3500	< 0.0060	< 0.0900	< 0.0150
Cs-134		< 0.0002	< 0.0003	< 0.0004	< 0.0002
Cs-137		< 0.0002	< 0.0003	< 0.0004	< 0.0002
Ba-140		< 0.0221	< 0.0060	< 0.0390	< 0.0100
La-140		< 0.0073	< 0.0028	< 0.0150	< 0.0037
Ce-141		< 0.0009	< 0.0005	< 0.0021	< 0.0008
Ce-144		< 0.0006	< 0.0010	< 0.0026	< 0.0013

WI DHFS data		LAC-2, Lock & Dam #8			
Radioisotope		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7		0.039 +- 0.002	0.052 +- 0.002	0.068 +- 0.003	0.047 +- 0.002
Mn-54		< 0.0002	< 0.0005	< 0.0005	< 0.0002
Co-58		< 0.0003	< 0.0005	< 0.0007	< 0.0003
Fe-59		< 0.0012	< 0.0012	< 0.0022	< 0.0007
Co-60		< 0.0002	< 0.0004	< 0.0006	< 0.0002
Zn-65		< 0.0004	< 0.0009	< 0.0011	< 0.0005
Nb-95		< 0.0008	< 0.0007	< 0.0014	< 0.0004
Zr-95		< 0.0006	< 0.0009	< 0.0014	< 0.0005
Ru-103		< 0.0005	< 0.0006	< 0.0010	< 0.0003
Ru-106		< 0.0014	< 0.0034	< 0.0043	< 0.0016
I-131		< 0.2700	< 0.0080	< 0.0700	< 0.0070
Cs-134		< 0.0002	< 0.0004	< 0.0004	< 0.0002
Cs-137		< 0.0001	< 0.0004	< 0.0004	< 0.0002
Ba-140		< 0.0346	< 0.0090	< 0.0360	< 0.0060
La-140		< 0.0093	< 0.0033	< 0.0190	< 0.0023
Ce-141		< 0.0008	< 0.0011	< 0.0013	< 0.0006
Ce-144		< 0.0006	< 0.0023	< 0.0016	< 0.0010

Radioisotopes other than those listed were not detected.

Table 7. WI DHFS TLD network for the LACBWR environmental monitoring program.

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Date Placed:	01/13/04	04/13/04	07/13/04	10/12/04
Date Removed:	04/13/04	07/13/04	10/12/04	01/11/05
Days in the Field:	91	91	91	91
Individual quarterly data is reported as: mR / Standard Quarter +- combined total uncertainty				
Location:				
LAC-T1	13.0 +- 2.6	13.1 +- 2.6	14.6 +- 2.9	15.3 +- 3.1
LAC-T2	11.1 +- 2.2	11.5 +- 2.3	12.0 +- 2.4	13.5 +- 2.7
LAC-T3	14.9 +- 3.0	14.8 +- 3.0	16.4 +- 3.3	17.2 +- 3.4
LAC-T4	13.8 +- 2.8	13.6 +- 2.7	15.5 +- 3.1	16.1 +- 3.2

Table 8. WI DHFS analysis results of fish samples collected for the LACBWR environmental monitoring program.

Measurements in units of pCi/kg (wet)

Collection date	03/23/04	03/23/04	06/14/04	06/14/04
Type	carp	walleye	northern pike	carp
Gamma isotopic				
K-40	2900 +- 130	3800 +- 300	3460 +- 140	3160 +- 130
Mn-54	< 21	< 39	< 13	< 16
Co-58	< 19	< 54	< 19	< 18
Fe-59	< 60	< 120	< 45	< 53
Co-60	< 20	< 42	< 14	< 16
Zn-65	< 45	< 90	< 34	< 41
Nb-95	< 25	< 60	< 22	< 23
Zr-95	< 38	< 100	< 28	< 31
Cs-134	< 16	< 37	< 12	< 13
Cs-137	< 19	< 35	< 13	< 13

Collection date	08/17/04	08/17/04	10/07/04	10/07/04
Type	carp	walleye	walleye	carp
Gamma isotopic				
K-40	3310 +- 110	3820 +- 130	3930 +- 130	3280 +- 100
Mn-54	< 14	< 16	< 15	< 6
Co-58	< 19	< 23	< 16	< 7
Fe-59	< 60	< 80	< 38	< 15
Co-60	< 14	< 18	< 16	< 7
Zn-65	< 33	< 44	< 38	< 15
Nb-95	< 37	< 39	< 17	< 7
Zr-95	< 37	< 45	< 29	< 12
Cs-134	< 11	< 13	< 13	< 6
Cs-137	< 12	< 13	< 15	< 6

Radioisotopes other than those reported were not detected.

Table 9. WI DHFs analysis results of surface water samples collected for the WI DHFS environmental monitoring program.

Measurements in units of pCi/liter

WI DHFS data		LAC-2, (Lock & Dam #8)			
Collection date		01/13/04	04/13/04	07/13/04	10/12/04
Gross Alpha-Sol		< 2.3	< 1.8	< 2.0	< 2.3
Gross Beta-Sol		< 2.4	3.3 +- 1.4	4.0 +- 2.0	4.0 +- 2.0
Gross Alpha-Insol		< 1.4	< 1.2	< 1.3	< 1.2
Gross Beta-Insol		< 2.5	< 2.3	< 2.4	< 2.5
H-3		< 300	< 300	< 300	< 300
Sr-89		< 0.3	< 0.5	< 0.7	< 0.4
Sr-90		< 0.4	< 0.3	< 0.4	0.5 +- 0.2
Gamma isotopic					
Mn-54		< 7	< 22	< 3	< 11
Co-58		< 6	< 19	< 3	< 10
Fe-59		< 22	< 41	< 6	< 20
Co-60		< 9	< 22	< 3	< 11
Zn-65		< 14	< 39	< 6	< 22
Nb-95		< 7	< 21	< 3	< 9
Zr-95		< 14	< 38	< 4	< 18
I-131		< 9	< 26	< 3	< 13
Cs-134		< 7	< 21	< 3	< 10
Cs-137		< 7	< 21	< 3	< 10
Ba-140		< 28	< 90	< 11	< 41
La-140		< 13	< 27	< 5	< 13

WI DHFS data		LAC-3, discharge channel			
Collection date		01/13/04	04/13/04	07/13/04	10/12/04
Gross Alpha-Sol		< 2.3	< 1.8	< 2.0	< 2.3
Gross Beta-Sol		< 2.4	4.0 +- 1.4	4.0 +- 2.0	3.0 +- 2.0
Gross Alpha-Insol		< 1.4	< 1.2	< 1.3	< 1.3
Gross Beta-Insol		< 2.5	< 2.3	< 2.4	< 2.5
H-3		< 300	< 300	< 300	< 300
Sr-89		< 0.3	< 0.6	< 1.0	< 0.5
Sr-90		< 0.4	< 0.4	0.7 +- 0.4	< 0.4
Gamma isotopic					
Mn-54		< 7	< 9	< 6	< 6
Co-58		< 7	< 9	< 6	< 5
Fe-59		< 18	< 17	< 12	< 10
Co-60		< 9	< 10	< 7	< 6
Zn-65		< 16	< 17	< 13	< 11
Nb-95		< 7	< 9	< 6	< 5
Zr-95		< 16	< 17	< 10	< 8
I-131		< 8	< 12	< 9	< 5
Cs-134		< 8	< 10	< 7	< 6
Cs-137		< 7	< 10	< 7	< 5
Ba-140		< 27	< 39	< 25	< 17
La-140		< 12	< 11	< 8	< 7

Radioisotopes other than those reported were not detected.

Table 10. WI DHFS analysis results of bottom sediments collected for the LACBWR environmental monitoring program.

Measurements in units of pCi/kg (dry)

WI DHFS data

Collection	06/23/04	06/23/04	06/23/04	08/04/04	08/04/04	08/04/04
Location	upstream LAC-2	discharge LAC-3	downstream LAC-4	upstream LAC-2	discharge LAC-3	downstream LAC-4
Analysis						
gross alpha	< 6000	< 6000	< 6000	< 7000	< 7000	< 7000
gross beta	10000 +- 4000	9000 +- 4000	19000 +- 4000	15000 +- 4000	< 6000	21000 +- 4000
Gamma isotopic						
K-40	6700 +- 200	5600 +- 200	12900 +- 300	13300 +- 400	4850 +- 130	14200 +- 400
Mn-54	< 18	< 11	< 6	< 16	< 3	< 6
Co-58	< 17	< 12	< 6	< 27	< 6	< 15
Fe-59	< 50	< 29	< 16	< 100	< 20	< 70
Co-60	< 20	< 13	< 6	< 18	104 +- 3	< 5
Zn-65	< 50	< 33	< 17	< 56	< 10	< 21
Nb-95	< 26	< 16	< 9	< 70	< 13	< 60
Zr-95	< 38	< 22	< 11	< 48	< 12	< 32
Cs-134	< 24	< 13	< 7	< 22	< 4	< 7
Cs-137	19 +- 5	181 +- 9	< 5	73 +- 7	220 +- 5	< 5

Naturally occurring radioisotopes such as radium-226 (^{226}Ra), bismuth-214 (^{214}Bi), lead-214 (^{214}Pb), actinium-228 (^{228}Ac), bismuth-212 (^{212}Bi) and lead-212 (^{212}Pb) from the naturally occurring uranium-238 (^{238}U) and thorium-232 (^{232}Th) decay series are commonly detected but have not been quantified or reported.

Radioisotopes other than those reported were not detected.

Table 11. WI DHFS analysis results for vegetation and soil samples collected for the LACBWR environmental monitoring program.

Measurements in units of pCi/kg (wet)

Collection date	05/24/04	05/24/04	09/07/04	09/07/04
Collection type	vegetation	vegetation	vegetation	vegetation
Location	LAC-5	LAC-6	LAC-5	LAC-6
Analysis				
gross alpha (wet)	< 1300	< 1300	< 1600	< 1900
gross beta (wet)	5700 +- 1000	4400 +- 900	6500 +- 1200	6200 +- 1400
Gamma isotopic				
Be-7	1700 +- 100	2300 +- 200	910 +- 140	1100 +- 200
K-40	4900 +- 200	3300 +- 400	6000 +- 400	4300 +- 300
Mn-54	< 26	< 60	< 51	< 60
Co-58	< 31	< 70	< 48	< 47
Fe-59	< 70	< 140	< 120	< 110
Co-60	< 30	< 70	< 60	< 50
Zn-65	< 60	< 110	< 110	< 120
Nb-95	< 29	< 70	< 54	< 60
Zr-95	< 60	< 120	< 90	< 100
I-131	< 70	< 80	< 60	< 70
Cs-134	< 22	< 60	< 46	< 50
Cs-137	< 26	< 70	< 49	< 60
Ba-140	< 180	< 270	< 190	< 240
La-140	< 60	< 110	< 70	< 70

Collection date	05/24/04	05/24/04	09/07/04	09/07/04
Collection type	soil	soil	soil	soil
Location	LAC-5	LAC-6	LAC-5	LAC-6
analysis				
gross alpha (dry)	< 6000	< 6000	< 6000	12000 +- 6000
gross beta (dry)	35000 +- 5000	18000 +- 4000	48000 +- 6000	24000 +- 5000
Gamma isotopic				
K-40	31700 +- 800	14300 +- 400	38400 +- 1000	12000 +- 300
Mn-54	< 29	< 28	< 25	< 10
Co-58	< 34	< 37	< 24	< 10
Fe-59	< 110	< 100	< 60	< 22
Co-60	< 32	< 29	< 28	< 11
Zn-65	< 90	< 90	< 80	< 31
Nb-95	< 47	< 50	< 26	< 12
Zr-95	< 60	< 70	< 42	< 18
Cs-134	< 33	< 50	< 32	< 14
Cs-137	98 +- 9	< 27	43 +- 8	< 10

Naturally occurring radioisotopes such as radium-226 (^{226}Ra), bismuth-214 (^{214}Bi), lead-214 (^{214}Pb), actinium-228 (^{228}Ac), bismuth-212 (^{212}Bi) and lead-212 (^{212}Pb) from the naturally occurring uranium-238 (^{238}U) and thorium-232 (^{232}Th) decay series are commonly detected but have not been quantified or reported.

Radiosotopes other than those reported were not detected.